STUDENT ID NO

MULTIMEDIA UNIVERSITY

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FINAL EXAMINATION

TRIMESTER 1, 2016/2017

DCS5068-DATA STRUCTURE & ALGORITHMS

(DIT)

10 OCTOBER 2016
9.00 am – 11.00 am
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This question paper consists of **8** pages **2** sections.
2. **SECTION A**: Answer **ALL** questions in the OMR sheet provided.
3. **SECTION B**: Answer **ALL** questions in the answer booklet provided.

SECTION A (20 Marks)

Instruction: *Please mark A for TRUE statement or* ***B*** *for FALSE statements in the OMR sheet provided.*

1. A stack is a data structure characterized by the first item that goes in will be the first item that goes out.

2. The addition and deletion process of elements in a stack only occur at one end called the top of the stack.

3. The processes for adding and removing an item from a stack are called *popping* and *pushing* respectively.

4. The operator comes after its two operands in postfix notation which is also known as reverse polish notation (RPN).

5. A queue is a sequence of items to which new items can be added at one end (head) and only removed from the other end (tail).

6. The characters 'D', 'C', 'B', 'A' are placed in a queue (in the order they are written) and then removed one at a time. They will be removed in the order of 'A', 'B', 'C','D'.

7. A list is a collection of nodes, where each node contains a data along with information about the next node.

8. Every node except the last node in a singly linked list contains the address of the next node.

9. The length of a linked list is the number of nodes in the list.

10. It is not possible to create an ordered linked list.

11. A doubly linked list can be traversed in either direction (forward and backward).

12. A linked list is different from an array as an array is fixed in size but a linked list is dynamically sizeable.

13. A head note can be deleted by copying the content of the second node to the head node.

14. The linked stack is empty when the top pointer is NULL.

15. The stack will never be full in a linked stack implementation.

Continued ...

16. The last element pushed into a nonempty linked stack will be the top element.

17. To push new item into a linked stack, a new node must be created. The new item is put into the new node and then push the node onto the stack.

18. The rear and front pointers are NULL when the linked queue is empty.

19. The new element is appended at the head of the linked list in linked list implementation of a queue.

20. A pointer-based implementation of a queue must use a linear linked list with two pointers, one to the front and one to the back.

SECTION B (80 Marks)

Instruction: *Answers all questions in the answer booklet provided.*

QUESTION 1 [20 marks]

a) Write a full C++ program based on the sample output screen and requirements given below. (17marks)

- Create a structure called *Person*. The data members are:
  - *name* : string
  - *ic* : string
  - *cc* : int
  - *roadtax* : float
- Define a function named *Define_Tax(...)* to define a tax based on the table given below.
  - Using *if..else* statement:

Engine Capacity (CC)	Tax
CC less than equal to 1000	55.50
CC less than equal to 2000 and more than 1000	65.50
CC less than equal to 3000 and more than 2000	75.50

  - Return tax to the *main( )* function .
- In *main()* function,
  - Declare a structure variable called *P*.
  - Prompt the user to enter *name*, *ic* and *cc*.
  - Call a function *Define_Tax(...)* and send a parameter *cc*.
  - Display the *name*, *ic*, *cc* and *roadtax* to the user.

Sample output screen:

```
Enter Name: Auni Damia
Enter IC: 140215145202
Enter Engine Capacity(CC): 1300

Name: Auni Damia
IC: 140215145202
Engine CC: 1300
Roadtax: RM 65.50
```

Continued ...

b) Trace and write the output produced by the C++ program below. (3 marks)

```
#include<iostream>
using namespace std;
int main()
{
      int m[5]={22,44,55};
      int p;
      int *n;
      int *q;
      n=m;
      q=&p;
      cout<<"n:"<<*n;
      *q=*n+4;
      cout<<"p:"<<p;
      n[3]=*q*2;
      cout<<"n:"<<n[3];
      if(n[3]<n[2])
      {
            n[4]=66;
      }
      cout<<"m:"<<m[4];
      n=q;
      *q=p/2;
      cout<<"*q:"<<*q;
      *n=m[0]+m[3];
      cout<<"p:"<<p;
}
```

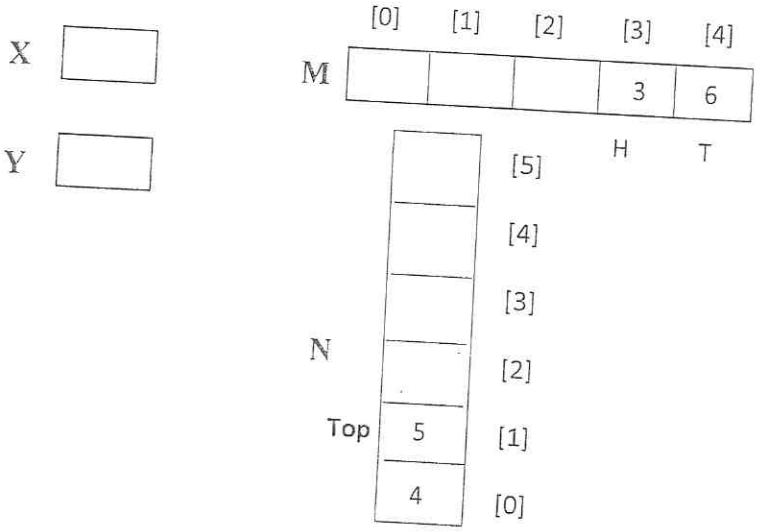
QUESTION 2 [20 marks]

a) Given the values of integers A, B, C and D are 4, 6, 8, 9 respectively. Calculate the value based on the following expressions below. (4 marks)

i. A B C * D + –

ii. A B * C D * – A /

b) Suppose *M* is a cyclic queue of integers with five elements and *N* is a stack of integers with six elements. There are two integers *X* and *Y*. Draw a sequence diagrams of *M*, *N*, *X* and *Y* after each of the following operations: (11 marks)



i. `M.append(7);`

ii. `X= N.push(30);`

iii. `Y= M.serve( );`

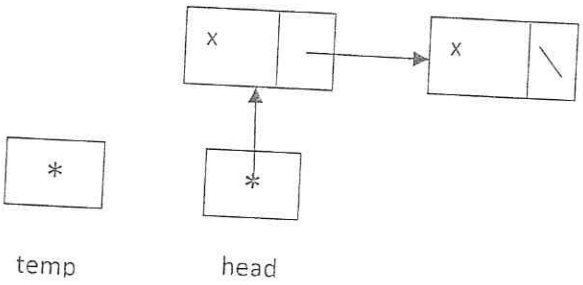
iv.
```
if (M.serve( ) > N.pop( ) )
{
        M.append(9);
}
```

v. `M.append(y*2);`

vi.
```
for (i=3; i<=5; i++)
{
        N.push(2*i);
}
```

c) Below is a diagram that shows a linked list that contains two linked data. Write a code to insert a new linked data using a backward technique based on the following instructions.

(5 marks)



i. Write a *for...loop* to repeat the statement for three times.

ii. Create a new node that has a new data and the link of the node must be pointing to the previous node.

```
node *head, *temp;
int i,x;
head = new node;
cin>>x;
head->data = x;
head->next = null;

.....(i).....
{
 .....
 .....(ii).....
 .....
 .....
};
```

QUESTION 3 [20 marks]

a) By using binary search, show step by step on how to find the target **65** in the data **23, 9, 54, 13, 40,** and **25**. The following are the variables declared in the binary search algorithm. (9 marks)

```
int table [6], target, first, last, mid;
```

Integer						
Index	[0]	[1]	[2]	[3]	[4]	[5]

b) Assume a hash table with 6 locations and the hashing function h(x) = x%6. Show the index for each key and the result of the hash table when the following integers are inserted in the order given. Use Quadratic Probing to solve the collision.

(5 marks)

9, 15, 18, 25, 26, 28

c) Given an array that contains the elements as shown in the diagram below, sort the sequence of numbers in **descending order** by using **Merge Sort**. (6 marks)

35	63	22	58	41

Continued ...

QUESTION 4 [20 marks]

a) Draw a binary tree for the algebraic expression below:

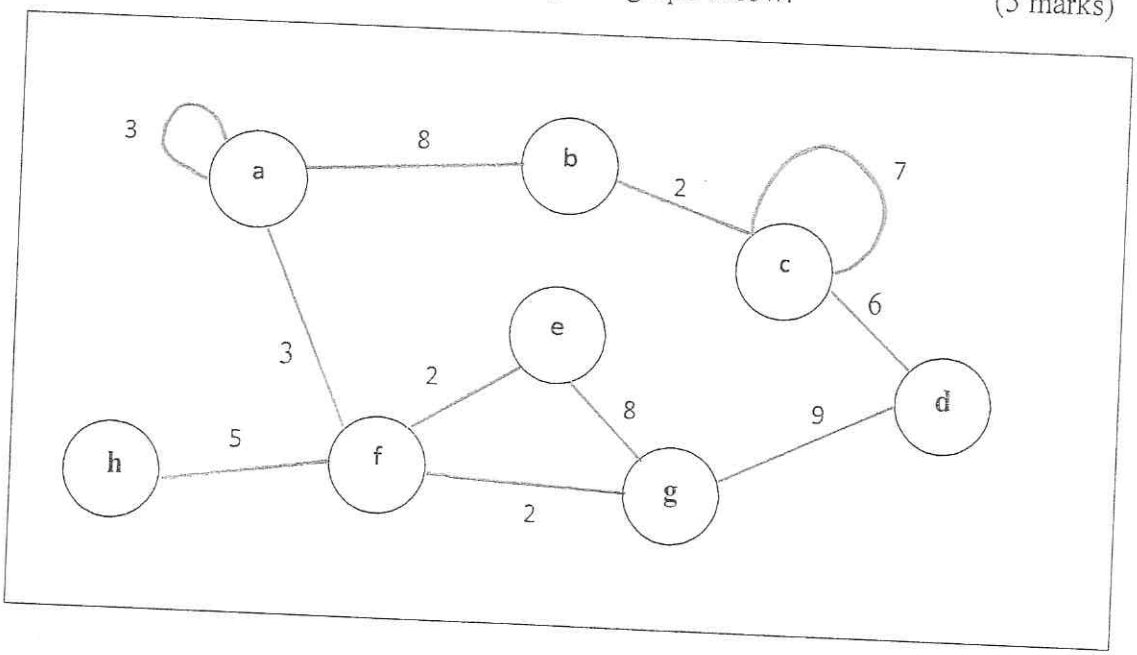
(8 marks)

$$(7+3)/2+[(2*2+5)-(3*3)]$$

i. From the binary tree, derive the preorder algebraic expression. (3.5 marks)

ii. From the binary tree, derive the postorder algebraic expression. (3.5 marks)

b) Derive an adjacency matrix based on the given graph below: (5 marks)



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